Technical Disclosure Commons

Defensive Publications Series

July 2021

ADAPTIVE 3D PRINTING PROCESS FOR PRE-PROCESSING AND POST-PROCESSING USER PREFERENCES

HP INC

Adaptive 3D Printing Process for Pre-Processing and Post-Processing User Preferences

Abstract: A 3D printing process that can adapt printing parameters of a 3D printer to the characteristics of pre- and post-processing devices used in conjunction with the 3D printer.

This disclosure relates to the field of additive manufacturing

A technique is disclosed that allows a 3D printer to adapt the printing process to different preprocessing and post-processing user preferences, operations and devices, while preserving end-to-end quality and robustness.

In many powder-based 3D printing systems today, the unpacking of the printed parts is performed manually by the operators. After printing a build using the 3D printer, the build unit is disconnected from the printing unit containing all the 3D printed parts. Usually, once the powder of the build unit is cold enough to extract the parts, the unit is emptied, loaded with material and connected back to the printer to start a new printing process. The cooling of a build inside the build unit takes a considerable amount of time and the unit cannot be used for other purposes during this time.

However, in some newer 3D printing systems, a warm build can be extracted out of the build unit, just after the end of the printing process, for external cooling. This allows the 3D printing system to begin a second build sooner than if the build remained in the system until it was cooled. Builds cooled externally under a natural cooling unit ("NCU") are usually printed together with a cage (or build envelope) surrounding the parts composing the build. The cage ensures that the print quality of the non-cooled parts is not affected do to the early extraction while the build is still warm.

Furthermore, new pre-processing and post-processing solutions and devices are enriching the 3D printing environment. One such post-processing device is an automatic unpacking and cleaning station. Automatic unpacking stations require a new cage design, and different cage designs are needed based on the device in which the cleaning of the parts will be performed.

According to the present disclosure, a cage design can be defined that optimizes the performance of the cleaning of the parts under an automatic unpacking station while preserving the part quality of the printed parts by adapting the printer behavior to the mechanism in which cleaning of the parts will be performed. More generally, while the printing parameters defining the printing process are usually specific per material and print mode, to accommodate automatic unpacking station printing parameters are enhanced by characterizing them according to the pre-processing and post-processing user preferences, operations and devices, selected when submitting a job into a 3D printer.

To perform external cooling using an NCU, the user submits a job to the printer using the cooling profile of type “extract” through an external software application. To preserve the part quality of the non-cooled parts during the early extraction, an automatically-generated cage or envelope is printed around them. The cage encloses all the user parts and the build powder around them, enabling the extraction of the warm parts for external cooling. Then operators manually break the cage, extract the parts, and perform the manual cleaning. While there may be different cage designs (solids, with holes of different sizes and shapes, grids, wall thickness, etc.) for different materials and part profiles, the basic cage requirement is the ability to be easily broken and minimize the material and ink usage, in a way that the quality of the user parts of the build remains the same after its early extraction and without being affected by the printed build envelope. However, in an automatic unpacking station the printing parameters also need to be

The 3D printer implements the pre-processing and post-printing user preferences implements the following steps:

1. User configuration

The user plans in the external software submission tool the pre-processing and post-processing operations and devices that will be used in the whole process, in addition to the job preparation for printing.

2. Job ticket update

These user preferences are stored as part of the job ticket submitted to the printer. The job ticket contains the 3D model describing the job to be printed together with the printing resources describing how its parts will be printed (print-mode, cooling profile, material properties, etc.) Additional features or profiles describing pre-processing and post-processing activities which take place outside the 3D printer are also included. For example, in an automated unpacking and cleaning station, unpacking profiles (both manual and automatic) may be included so that the printer knows in which device the unpack and cleaning tasks will be performed. With this information, the 3D printer adapts the cage generation process appropriately for the station.

3. Adaptive printing process

According to the ticket description, the printer (and all involved subsystems receiving the ticket) adapts its behavior according to the activities planned by the user. In this example, the printer adapts the cage generation process to perform the automatic unpack without affecting the performance of the cleaning task while preserving part quality.

For automatic unpacking and cleaning, the cage design may have faces which are unjointed, and not connected. A separation between all faces of the cage enables easy automatic cleaning of the parts. The size of the separation between faces is configurable and can be different for lateral faces and top and bottom lids. As a result, each face of the cage can be considered as a separated internally generated part, so each face can be designed following different strategies to generate a more flexible cage design. Also, its thickness can be different per each wall of the cage. Even the reporting of the consumption of the walls of the cage can be provided separately to the cloud for post-printing user analysis. Also, some walls of the cage can be discarded, and for example only top and bottom lids printed, to preserve part quality while making easier the cleaning of the parts under the automatic unpacking station.

4. Reporting

The printer behavior will be described by reporting via telemetry the user configuration together with the final printing configuration selected by the printer according to job ticket content that includes pre-and post printing activities and the devices in which they will be performed.

The disclosed technique advantageously provides a more robust and flexible end-to-end printing solution by adapting particularities of the printing process to specific ecosystems, devices and preferences. In particular, the solution optimizes the performance of the cleaning of the printed parts when the unpacking is performed in an automatic unpacking station, delivering same part quality as when the unpacking and cleaning is performed manually. The flexible cage process generation in which each face of the cage can be specified separately, including separation between them, achieves the best cleaning performance while preserving part quality when cleaning the parts in an automatic unpacking station.

Disclosed by Leticia Rubio, Sebastia Cortes i Herms, and Pablo Dominguez Pastor, HP Inc.